CLAIMS

1. An actuator system, comprising:

A) an actuator including an armature and a coil operable by application of a coil drive thereto to conduct current and thereby tend to drive the armature to an end position from a rest position, to which the armature is biased to return in the absence of coil current;

B) a sound sensor so coupled to the actuator as to sense sound made by the armature in reaching the end position, the sound sensor generating a sensor output indicative of the sound that it senses;

C) a control circuit operable to begin applying coil drive to the coil at a first level and responsive to the sensor output's meeting a predetermined end-position-indicating criterion to change the coil drive to a different level great enough to keep the armature from returning to the rest position.

2. An actuator system as defined in claim 1 wherein the sound sensor includes a piezoelectric transducer.

3. An actuator system as defined in claim 2 wherein, if the sensor output does not meet the end-position-indicating criterion within a predetermined drive duration after the control circuit begins application of coil drive to the coil, the control circuit applies coil drive to the coil at a level higher than that at which it began application of coil drive to the coil.

4. An actuator system as defined in claim 3 wherein the different level is lower than the first level.

5. An actuator system as defined in claim 2 wherein:

A) the actuator system includes a housing that contains the armature and coil; and

B) the piezoelectric transducer is secured to the housing.

6. An actuator system as defined in claim 2 wherein the different level is lower than the first level.

7. An actuator system as defined in claim 1 wherein, if the sensor output does not meet the end-position-indicating criterion within a predetermined drive duration after the control circuit begins application of coil drive to the coil, the control circuit applies coil drive to the coil at a level higher than that at which it began application of coil drive to the coil.

8. An actuator system as defined in claim 7 wherein the different level is lower than the first level.

9. An actuator system as defined in claim 7 wherein the control circuit stops applying the coil drive after the predetermined drive duration before driving the coil at the elevated first level.

10. An actuator system as defined in claim 1 wherein:

A) the system includes first and second coil terminals by which the control circuit applies the coil drive to the coil;

B) the system includes first and second sensor terminals by which the control circuit receives the sensor output from the sound sensor; and

C) the second coil and sensor terminals are the same.

11. An actuator system as defined in claim 1 wherein the different level is lower than the first level.

12. A flow-control system comprising:

A) a valve operable between open and closed states;

B) an actuator including an armature operatively connected to the valve and further including a coil operable by application of a coil drive thereto to conduct current and thereby tend to drive the armature to an end position, in which the

armature holds the valve in one of said open and closed states, from a rest position, to which the armature is biased to return in the absence of coil current and thereby hold the valve in the other of said open and closed states;

C) an endpoint detector that detects the armature's reaching the end position and responds thereto by generating a detector output indicative thereof; and

D) a control circuit operable to begin applying coil drive to the coil at a first level and responsive to the detector output indicative of the armature's reaching the end position to change the coil drive to a different level great enough to keep the armature from returning to the rest position.

13. A flow-control system as defined in claim 12 wherein the different level is lower than the first level.

14. A flow-control system as defined in claim 12 wherein:

A) the flow-control system additionally includes an object sensor that produces an object sensor output; and

B) the control circuit's application of the coil drive to the coil is dependent on the object-sensor output.

15. A flow-control system as defined in claim 14 wherein:

A) the endpoint detector includes a sound sensor that is so coupled to the actuator as to sense sound made by the armature in reaching the end position and generates a sensor output indicative of the sound that it senses; and

B) the detector output indicates that the armature has reached the end position if the sensor output meets a predetermined current-termination criterion.

16. A flow-control system as defined in claim 15 wherein the sound sensor includes a piezoelectric transducer.

17. A flow-control system as defined in claim 14 wherein the different level is lower than the first level.

18. A flow-control system as defined in claim 12 wherein:

A) the endpoint detector includes a sound sensor that is so coupled to the actuator as to sense sound made by the armature in reaching the end position and generates a sensor output indicative of the sound that it senses; and

B) the detector output indicates that the armature has reached the end position if the sensor output meets a predetermined current-termination criterion.

19. A flow-control system as defined in claim 18 wherein the different level is lower than the first level.

20. A flow-control system as defined in claim 18 wherein the sound sensor includes a piezoelectric transducer.

21. A flow-control system as defined in claim 12 wherein, if the sensor output does not meet the end-position-indicating criterion within a predetermined drive duration after the control circuit begins application of coil drive to the coil, the control circuit applies coil drive to the coil at a level higher than that at which it began application of coil drive to the coil.

22. A flow-control system as defined in claim 21 wherein the different level is lower than the first level.

23. For controlling an actuator including an armature and a coil operable by application of a coil drive thereto to conduct current and thereby tend to drive the armature to an end position from a rest position, to which the armature is biased to return in the absence of coil current, a method comprising:

A) applying coil drive to the coil at a first level;

B) determining whether the armature has reached the end position; and

C) if so, changing the coil drive to a level lower than the first level but great enough to keep the armature from returning to the rest position.

24. An actuator system, comprising:

an actuator including an armature and a coil constructed to displace said armature by application of a coil drive;

an armature sensor constructed to detect displacement of said armature; and

a control circuit constructed to apply to said coil said coil drive upon receiving a signal originated from an external object sensor, said control circuit being also responsive to an output from said armature sensor.

25. The actuator system of claim 24 installed in a flusher wherein said object sensor is constructed to detect a user leaving the flusher's vicinity.

26. The actuator system of claim 24 wherein said actuator includes a permanent magnet arranged to form a latching actuator.

27. The actuator system of claim 24 wherein said actuator includes a bias spring positioned and arranged to bias said armature toward its extended position.

28. The actuator system of claim 24 wherein said armature sensor is a sound sensor coupled to a housing of said actuator.

29. The actuator system of claim 24 wherein said sensor is a sound sensor arranged to sense sound made by said armature reaching an end position.

30. The actuator system of claim 24 wherein said actuator is non-latching, wherein said control circuit is constructed apply said coil drive to displace said armature to an end position from a rest position, and wherein said actuator includes a bias spring biased and arranged to return said armature to said rest position in the absence of said coil drive.

31. The actuator system of claim 30 wherein said control circuit is constructed to apply said coil drive initially at a first level and subsequently in response to said output from said sensor apply said coil drive at a second level.

32. The actuator system of claim 31 wherein said output from said sensor indicates said end position of said armature, and wherein said second level is smaller than said first level but great enough to keep said armature in said end position.

33. The actuator system of claim 31 wherein said output from said sensor indicates said armature not reaching said end position, and wherein said second level is larger than said first level.

34. The actuator system of claim 24 wherein said actuator is constructed as a latching actuator including a bias spring positioned and arranged to bias said armature toward its extended position and a permanent magnet arranged to hold said armature in a retracted position, wherein said control circuit is constructed apply said coil drive to displace said armature, and wherein said control circuit is constructed to remove said coil drive in response to said output from said sensor.

35. The actuator system of claim 24 wherein said actuator is constructed as a latching actuator including a bias spring positioned and arranged to bias said armature toward its extended position and a permanent magnet arranged to hold said armature in a retracted position, wherein said control circuit is constructed apply said coil drive of a first level to displace said armature, and wherein said control circuit is constructed to apply said coil drive of a second level in response to said output from said sensor.

36. The actuator system of claim 35 wherein said sensor indicates no motion of said armature and said second level of said coil drive being larger than said first level of said coil drive.

37. A battery-operated actuator system, comprising:

an actuator including an armature and a coil constructed to displace said armature by application of a coil drive;

a control circuit powered by a battery;

an armature sensor, powered by said battery, constructed to detect displacement of said armature and provide an output signal to said control circuit; and

an external object sensor, powered by said battery, constructed to provide an object sensor output to said control circuit, wherein said control circuit is constructed to apply to said coil said coil drive upon receiving said object sensor output originated from said object sensor or upon receiving said output from said armature sensor, and wherein said control circuit is constructed to generate said coil drive including different power levels.

38. The battery-operated actuator system of claim 37 installed in a flusher wherein said object sensor is constructed to detect a user leaving the flusher's vicinity.

39. The battery-operated actuator system of claim 38 wherein said actuator includes a permanent magnet arranged to form a latching actuator.

40. The battery-operated actuator system of claim 38 wherein said actuator includes a bias spring positioned and arranged to bias said armature toward its extended position.

41. The battery-operated actuator system of claim 38 wherein said armature sensor is a sound sensor coupled to a housing of said actuator.

42. The battery-operated actuator system of claim 38 wherein said armature sensor is a sound sensor arranged to sense sound made by said armature reaching an end

position.

43. The battery-operated actuator system of claim 38 wherein said actuator is non-latching, wherein said control circuit is constructed apply said coil drive to displace said armature to an end position from a rest position, and wherein said actuator includes a bias spring biased and arranged to return said armature to said rest position in the absence of said coil drive.